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THERMOELASTIC EFFECTS IN SEALS AND BRUSHES.(U)
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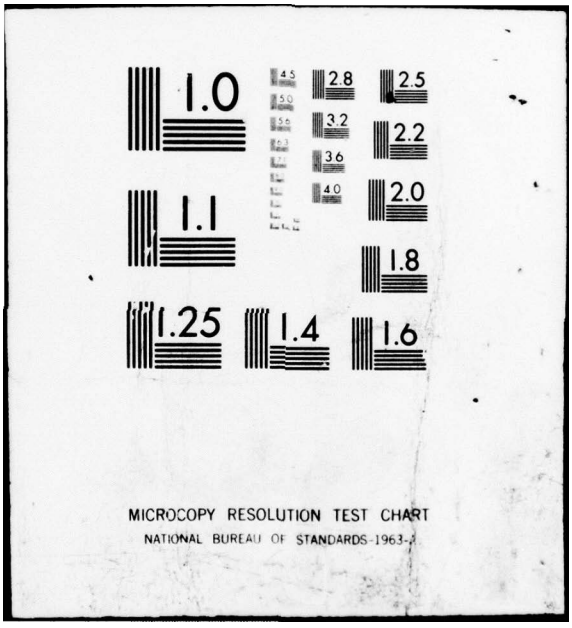
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

At Northwestern a series of studies have been carried out, pioneering the analysis of thermoelastic instabilities in sliding systems. Such instabilities influence the mild wear/severe wear transition, and participate in other failure modes, of seals and other systems.

Findings have been reviewed in the report "Thermomechanical Effects in Sliding Wear". Analyses are continuing on seal dynamics, and transient behavior

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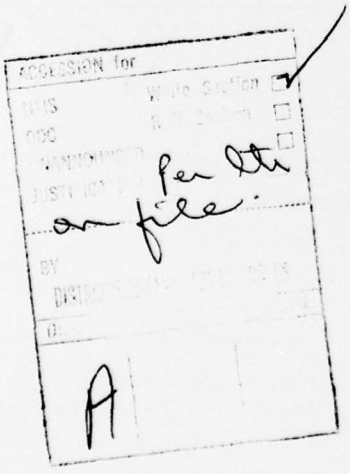

Abstract

At Northwestern a series of studies have been carried out, pioneering the analysis of thermoelastic instabilities in sliding systems. Such instabilities influence the mild wear/severe wear transition, and participate in other failure modes of seals and other systems.

Findings have been reviewed in the report "Thermomechanical Effects in Sliding Wear". Analyses are continuing on seal dynamics, and transient behavior of brushes. Two apparatuses are available and have been used in experiments in the present year. These findings are being summarized in papers and reports presently under preparation.

OBJECTIVE: The program objective has been to provide an understanding of thermoelastic effects which limit the application of seals and brushes. Specifically, to carry out critical experiments closely coordinated with ongoing analyses to provide tests of the models being developed.

BACKGROUND. When we at Northwestern first mentioned thermoelastic effects in sliding contact (and associated instabilities) to ONR, and suggested it as an area for useful fundamental engineering research, it was not clear that such effects were much more than a curiosity. Since that time: (1) our understanding of the fundamental phenomena has improved to the point where we have a relatively full understanding of the physics involved and, indeed, have nearly completed assembly of a monograph on the subject; and (2) it has become clear that related phenomena may limit such application as brushes in homopolar motors as well as submarine shaft seals; (3) an increasing variety of new applications are called to our attention including engine fires in military aircraft ignited by related high speed rubbing phenomena, exacerbated by thermoelastic instability; (4) more recently we have preliminary evidence that thermoelastic instability may influence the failure of some classes of elastohydrodynamic contact.

Throughout our program we have proceeded in a combined process of modeling and experimentation, step by step, and in the present contract year have achieved some important landmarks. Specifically we have carried out experimental work on seals and theoretical studies on electrical brushes. The results may be summarized as follows:

Experimental, Seals. Experiments in an improved seal apparatus have been carried out and have led to a paper accepted by ASME (see item 5 reference).

Findings

The experimental studies have shown several inadequacies in present models and have suggested improved models. The improved model has been analyzed and a progress report is in preparation.

Analytical, Brushes. Earlier developed analytical approaches were to be extended to brushes, allowing for electrical heating, conductivity of both bodies, frictional heating, and possibly, forced cooling.

Findings

This work has been successful and a paper is scheduled for an international conference on electrical contacts in September, 1978. Analysis of transient effects is still in progress. A draft report has been prepared and submitted to J. R. McNab of Westinghouse for his comments.

It is of interest that NASA has supported a set of runs on our seal apparatus and this has led to two reports now in preparation. As soon as they are reproduced copies will be transmitted to ONR.

Presentations

Thermoelastic Effects in Electrical Contacts
DARPA Coordinating Meeting, Westinghouse Research Laboratory, Pittsburgh, Pa., June 18-19, 1978.

Brushes with High Current and High Sliding Speed
DARPA Coordinating Meeting, Westinghouse Research Laboratory, Pittsburgh, Pa., August 1-2, 1978.

Thermoelastic Effects in Frictionally Heated Line Contact of Slablike Bodies
ASME/ASLE Joint Conference, Kansas City, Mo.

The Thermoelastic Patch Contact Problem for Large Peclet Number
ASME/ASLE Joint Conference, Kansas City, Mo., October 3-6, 1977.

Thermomechanical Effects in Sliding Wear
International Conference on Fundamentals of Tribology, Cambridge, Mass., June 19-22, 1978.

Experiments on Liquid Lubricated Seals
NASA Seals Workshop, NASA Lewis Lab, Cleveland, Oh., September 28-29, 1977.

The Transition From Line to Point Contact
Leeds/Lyon Conference, September 19-22, 1978

The Transition From Line to Point contact
NASA Seals Workshop, NASA Lewis Lab, Cleveland, Oh.

Seal Research
A one day presentation, representatives of Crane Packing Co., Northwestern University, August 22, 1978.

Papers Published

1. S. R. Heckmann and R. A. Burton, "Thermoelastic Effects in Frictionally Heated Line Contact of Slablike Bodies," ASME Trans., Ser. f, 100 (1978), pp. 136-141.

2. S. R. Kilaparti and R. A. Burton, "The Thermoelastic Patch Contact Problem for Large Peclet Number," ASME Trans., Ser. f, 100, (1978) pp. 65-69.

3. R. A. Burton, "Thermomechanical Effects in Sliding Wear," International Conference on the Fundamentals of Tribology," June 19-22, 1978. To appear in the proceedings.

4. B. N. Banerjee and R. A. Burton, "Thin Film Flows with Thermoelastically Deformed Boundaries," Journal of Mechanical Engineering Science, 20, (1978).

5. B. N. Banerjee and R. A. Burton, "Experimental Studies on Thermoelastic Effects in Hydrodynamically Lubricated Face Seals," ASME Paper 78 Lub 11. Scheduled for ASME Trans.

6. R. A. Burton and S. R. Heckmann, "The Thermoelastic Transition From Line to Point Contact," Leeds/Lyon Conference, 19-22 Sept., 1978. To appear in conference proceedings.

7. C. P. Chen and R. A. Burton, "Thermoelastic Effects in Brushes With High Current and High Sliding Speed," Ragnar Holm International Conference on Electrical Contacts, Chicago, 15 Sept., 1978. Scheduled to appear in conference proceedings.